Performance Support Concepts for Web-Based Informatics Instruction

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Duke University first offered World Wide Web (WWW) based courses in Nursing Informatics in January of 1997. The first class enrolled 18 nurses who were completing either a Post-Master's Certificate Program or were near completion of their Master's degree. Courses were designed around principles of advanced nursing practice, performance support, mastery learning, and virtual learning communities. Extensive learning assessment included traditional papers, real-world application projects, and a variety of pre and post-test measurements.

INTRODUCTION

Teaching, as we know it, was a medieval invention, designed to solve a problem where students did not have access to primary sources, and teachers created representations (lectures, texts) to acquaint students with materials they could not directly access or manipulate for themselves. As global connectivity and proliferation of information sources on the World Wide Web (WWW) changes our access to primary and secondary sources, the medieval problem that gave birth to traditional teaching paradigms has been mostly solved. The WWW provides both faculty and students with incredible opportunities for instructional environments that enhance learning productivity and foster true learning.

EVOLVING PARADIGMS

Teaching and Learning

As we approach a new millennium, American higher education struggles with soaring costs, increasing diversity, faltering revenues, a serious erosion of public confidence, and changing productivity standards for those who work in academia. Johnstone[1] suggested that the productivity problem in higher education stems from insufficient *learning*, and asserts that technology can make greater learning productivity possible when coupled with changes in pedagogy and a paradigm shift to individualized, self-paced mastery learning.

Although it might seem reasonable to expect that informatics courses would rely heavily on technology-based instructional methods, a January 1997 review of WWW based course offerings in informatics, leads one to believe that informatics instruction, for the most part, remains mired in traditional academic paradigms and pedagogy. It has been difficult for many educators to make the paradigm shift from traditional linear models, and cultures that focused on learning as an end and instruction as a means, to new paradigms of technology-based performance support. This fundamental shift in thinking is a difficult one to make. What we're beginning to see is transitional movement that computerizes traditional basic instructional models, and adds multimedia and other technology innovations to improve learning. But a full paradigm shift to performance support has yet to evolve in informatics education. Slow progression into this paradigm with careful evaluation of the problems and merits seems appropriate.

Most of us in the USA (and probably around the globe) were raised with pedagogy that trained us to sit glued in our chairs taking notes as fast as we could and generating our best guesses at what needed to be memorized for regurgitation on exams and papers. We were lectured by the *sage on the stage* -- and the educator's journals are filled with research about how little retention (therefore how little true learning) transpires with this form of pedagogy. In this paradigm, students of all ages and disciplines have become increasingly focused on grades rather than on learning.

Most of us were also raised in competitive learning environments where we tried to 'out-do' our classmates, or resigned ourselves to being 'inferior' when we couldn't successfully compete. The majority of today's work environments are too complex for isolated employees to accomplish their tasks and be productive working from a competitive attitude. Today, employers succeed when they generate environments for cooperative teamwork inside the organization, and view their competition as the external marketplace. Internal organizational competition is

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counterproductive for employees as well as the employer. Thus, we see an increasing need for multidisciplinary teamwork and cooperation in the workplace as well as the classroom. Logic then dictates that our teaching and learning paradigms must promote teamwork and cooperative learning environments. Since nursing remains a primarily female profession, the additional complications of gender roles and oppressed group behaviors complicate the development of authentic teamwork and cooperative learning in nursing. Developing teamwork and cooperation provides unique challenges for nurses and mandates innovative teaching strategies to effect changed behavior.

Virtual Learning Environments

New teaching and learning paradigms adopt a *guide on the side* attitude for the faculty role. Understanding that true learning takes effort, active participation, and involvement on the part of the learner, the new pedagogy involves creating structured learning environments for the student to navigate with assistance. The faculty's role is one of providing the structure, the resources, and the environment for learning, and is crucial to the process. But students who have spent most of their academic careers in old paradigm classrooms often find they grow frustrated with their *guide on the side* and desperately want the *sage on the stage* to just tell them what they need to know. This minimizes immediate frustration but rarely improves true lifelong learning.

Since web-based instruction is not limited to fixed times and places, teaching and learning opportunities exist 24 hours a day, seven days a week, from anyplace in the world with WWW access. This ***is*** the strength of Web-based learning strategies. The Web offers a potential to revolutionize education in similar fashion to the way it has revolutionized access to information and communications for users around the globe. However, a number of issues need to be addressed if the Web is to be applied successfully to deliver positive and effective learning experiences for students.

The advantages of traditional classroom instruction involve face-to-face opportunities to communicate with fellow students and ask questions of faculty. Libraries and other learning resources are usually readily available to the student. But traditional classroom paradigms are constrained by geography, expensive to maintain, and fairly inflexible in their delivery. Technology-based education has advantages of convenience and economy. Academic resource consumption is efficient, as virtually no resources are required until the student activates their client-computer to communicate with the server-based course materials. This process focuses the educational process on *learning* rather than teaching. Traditional expensive academic resources, that included large spaces and the utilities to serve them and human resources to maintenance them, can now be re-directed toward more efficient computing resources. Another advantage of technology-based education is that it can be self-paced at the learner's rate, and customized with multimedia and interactive options. But a disadvantage is that, left alone, this paradigm tends to provide anonymous learning experiences that isolate students and result in high drop-out rates[2]. In order to be successful, web-based education must find ways to replicate communication and crucial support mechanisms for the student.

Conceptualizing the Courses

A new program in nursing informatics was first approved through traditional academic channels at Duke University. Courses are focused on the developing field of nursing informatics, which combines nursing science, computer science, and information/decision science and examines related issues of applying nursing informatics within complex health care organizations and administrative structures. Students were required to have prerequisite knowledge that achieved basic personal productivity (computer) competencies. Content for the courses was directed toward assisting the student to understand relationships between the current state of nursing science, health care reform, and complex informatics issues.

Key Principles

The courses were conceptualized and designed around three key principles:

1). Expertise (advanced practice)
2.) performance support[4] and
3). mastery learning[5]

The first key principle centered around a philosophy that informatics knowledge and skills are most effectively applied by experts who are advanced practitioners in an area of specialization; applying the tools appropriately first requires expertise in the domain to which the tools are being applied. Duke University's faculty believe this expertise is best demonstrated by nurses who have completed graduate education in addition to their years of clinical experience. Thus the courses were limited to nurses who were completing either a Post-Master's certificate program, or were near the completion of their Master's degree.

Course Objectives

The first course was a two credit course titled "Issues in Nursing Informatics" that included content for historical aspects, on-line informatics resources, technology standards, professional standards, virtual

work environments, emerging technologies, privacy/security, quality improvement, and informatics roles. The second course focused on object oriented analysis and design as well as theoretical concepts, project management strategies, and decision support strategies. The final course, offered for the first time in the fall of 1997, includes a hands-on residency that develops a real-world project with a qualified mentor.

Performance Support

A second key principle was that the focus of instruction would be on performance support that assisted the learner in mastering nursing informatics knowledge and skills.

Since a key principle for the program was centered around concepts of performance support, it seemed reasonable to introduce these concepts as a part of the course content. These principles are also foundational for many of the informatics roles the students will fill when they have completed the program, thus performance support concepts applied to the student both as a learner and as a future informatician.

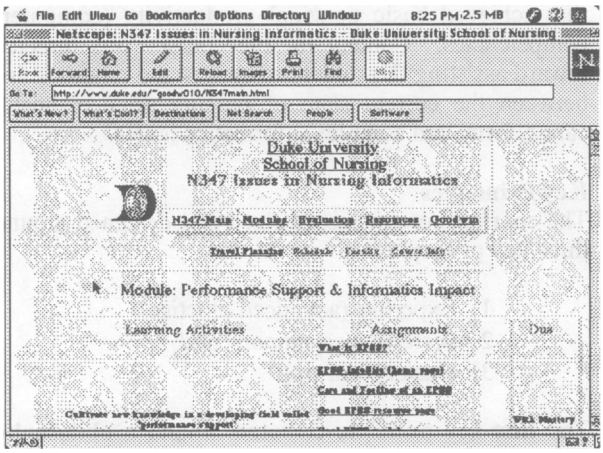

Figure 1. Intro to Performance Support Concepts

Performance support concepts for the courses were designed around American Nurses' Association documents for the scope[6] and standards[7] of nursing informatics practice, as well as concepts from the Secretary's Commission on Achieving Necessary Skills (SCANS)[8]. The SCANS report identified five competency skill areas and three foundational skill areas that are necessary for success in the workplace.

The five competency skill areas include:

1. Identification, organization, planning, and allocation of *resources*.
2. *Interpersonal* skills in working with others.
3. *Information* processing skills in acquiring and using information.
4. Understanding complex interrelationships and *systems*.
5. Working with a variety of *technologies*.

The three foundational skill requirements include:

1. *Basic Skills*: foundational abilities to read, write, calculate, listen, speak, etc.
2. *Thinking Skills*: creative and critical thinking, decision-making, problem-solving, and learning.
3. *Personal Quality Skills*: responsibility, self-esteem, sociability, self-management, honesty, integrity, etc.

Performance support, as envisioned by the faculty, was designed to facilitate advanced practice nurses in developing competencies and thinking skills that would enable them to meet professional informatics standards and function as proficient, but not (yet) expert, informatics nurses in health care workplaces. Performance support also included trying to replicate learning support that would be available in traditional classroom settings, as much as possible. Traditional dialogue and a sense of classroom that accompanies a traditional campus course is not readily available in self-paced individualized learning that is done from one's home via modem at any hour of the day or night. One of the challenges for this cyber-based course was to develop a virtual learning community where students felt comfortable in sharing questions and insights in nontraditional modes. To develop this sense of community, the first learning experiences involved a 13 hour intensive on-campus weekend in a state-of-the-art computer lab. The weekend learning experiences included some traditional pedagogy, but were primarily hands-on learning strategies that encouraged students to work cooperatively and collaboratively, with a goal of building familiarity, trust, and shared learning values.

The class included 18 nurses from North Carolina, California, Florida, Georgia, Indiana, and Massachusetts. Fifteen of the students had never attempted web-page development of any kind, but all were successful in completing their own introductory and personal web page (complete with pictures) by the end of the first weekend. If a student received e-mail or electronic seminar discussion from a fellow classmate, and couldn't remember who that person was, the personal web pages provided an opportunity to refresh their memory and build a sense of team and community.

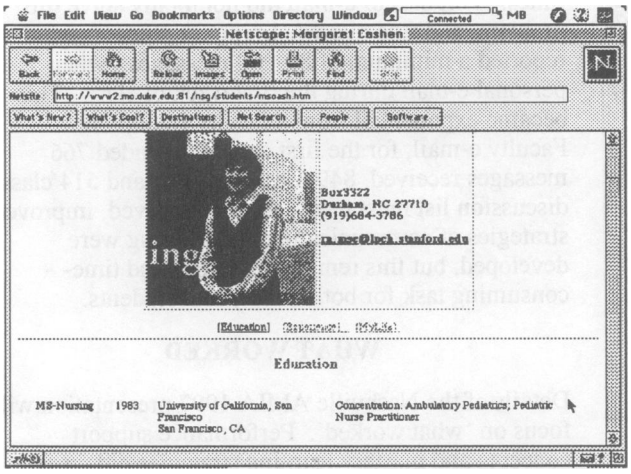

Figure 2. Sample student web page

Performance support has both intrinsic and extrinsic components. Intrinsic performance support is built into the system as a part of the design, and includes the user interface structure, the content itself, and the application/navigation logic and system functionality. Performance support concepts require that intrinsic elements be very user-friendly. An example of intrinsic performance support for the students to build their own personalized web pages was the use of Netscape Gold's[9] user-friendly editor, a template the student could edit and personalize (if they were not comfortable starting from a blank page), and personal mentors/tutors who were available to help with hands-on building during the first on-campus weekend. The goal is to minimize the user's psychological awareness of being 'in the software' and leave them with a feeling that they are simply doing their work, which, in this case, is the work of student learning exercises.

Extrinsic performance support includes those elements that are external to and not integrated into the course materials. The informatics courses found that extrinsic support was still primarily computer-mediated, with occasional telephone calls to technology-frustrated students. Extrinsic support included the e-mail and discussion list communications already mentioned, and a rather lengthy list of technology support people that students activated to assist them with numerous hardware and software problems, especially at the beginning of the course.

RESULTS

The faculty entered into the notion of web-based instructional performance support with careful planning but also some trepidation, considering the geographic dispersion and widely varied basic competency level of the entering students. With a combined key principle of mastery learning, it would be theoretically possible for the faculty to be inundated with support needs from students who were having trouble mastering the assignments. Lawyer-Brook and Sherry[10] reported that requested technical support was actually used by very few of the persons requesting it. Faculty concerns about possible overwhelming support needs by geographically dispersed informatics students did not develop, and what evolved was a learning community where the students usually asked for assistance and support from each other before they contacted the faculty. This helped the group develop a sense of teamwork and cooperation, and alleviated faculty concerns about being overwhelmed with support needs from students with different entering skill levels.

Performance Support and Mastery Learning

Course content included mastery learning that was designed with:

a). clearly defined and measurable learning outcomes
b). learning activities that could be self-paced and repeated until the student succeeded in mastery
c). real-world problems as the main component of instructional strategies

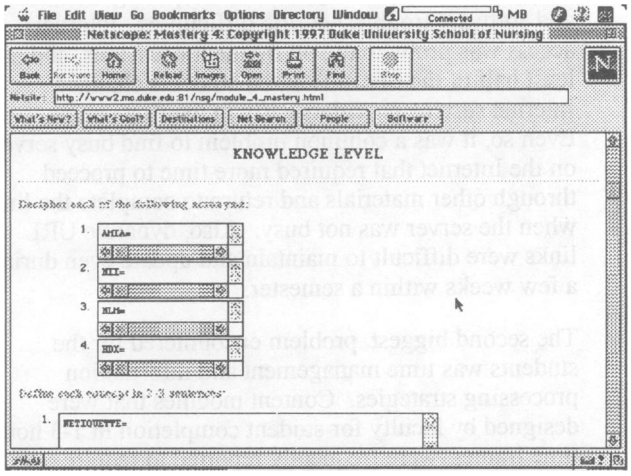

Figure 3. Lower Level Mastery Example

Students completed mastery materials after extensive on-line guided instruction and self-paced learning. Each mastery document included items that ranges from knowledge level through evaluation level, and where answers were not correct, the student was asked to revise and re-submit until mastery was accomplished. For the first course, half of the students saved their mastery submissions for the last two weeks of the course. While they eventually were successful, this was understandably problematic for faculty, and the process was changed for the second course.

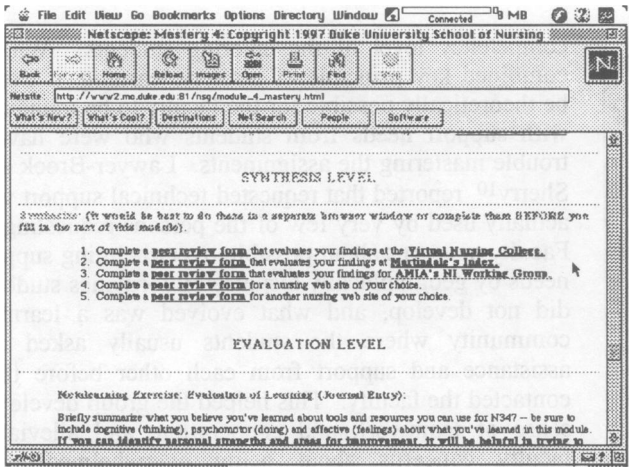

Figure 4. Higher Level Mastery Example

PROBLEMS ENCOUNTERED

The first problem encountered involved web-based forms (examples in Figures 3 and 4) where multiple problems with hardware and software left students extremely frustrated in trying to submit their mastery learning content for evaluation. Other problems encountered included incorrectly assessed (deficient) prerequisite skills, and personal computing hardware and software troubleshooting difficulties. Internet access was problematic on frequent occasions, and at least half of the distance-based students changed Internet service providers early in the first course. Even so, it was a common problem to find busy servers on the Internet that required more time to proceed through other materials and return to complete the link when the server was not busy. Also, dynamic URL links were difficult to maintain and update even during a few weeks within a semester.

The second biggest problem encountered for the students was time management and information processing strategies. Content modules that were designed by faculty for student completion in 1-3 hour time frames, were frequently reported to require 6-10 hours for students' to master the material. Over time, students designed information processing strategies that helped them remain focused on their mastery tasks while also organizing and filing other interesting URLs and links into folders and files for later review.

The third problem that also improved, as the courses progressed, involved an affective learning domain and a sense of virtual teams. Original plans intended to use Internet conferencing software for synchronous, real-time, 'virtual' seminars and conferencing. Hardware and software problems influenced a decision where this form of communication was optional for students during the first course. Most students continued to deal with feelings of isolation and exasperation at times. Volumes of e-mail did not totally solve this problem, and was overwhelming for students who reported a minimum of 80-100 messages in their personal e-mail during the first week of class. This became exponential from a faculty standpoint. Faculty e-mail, for the first course, included 766 messages received, 849 messages sent, and 514 class discussion list messages. As time evolved, improved strategies of communicating and filtering were developed, but this remains a tedious and time-consuming task for both faculty and students.

WHAT WORKED

Details of the Nashville AMIA 1997 presentation will focus on 'what worked'. Performance support concepts and mastery learning strategies did, in fact, work well for web-based informatics instruction. Pre and post-measurements provide evidence of increased knowledge and skills in nursing informatics. Other elements that worked included launching the courses with on-campus weekends, structured but self-paced learning experiences, personalized feedback between faculty and students, and development of a virtual learning community. Future plans include inter-institutional cooperation in further development of web-based informatics instruction.

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